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- *Disappearing Mammals*
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- *Butterflies and Moths*
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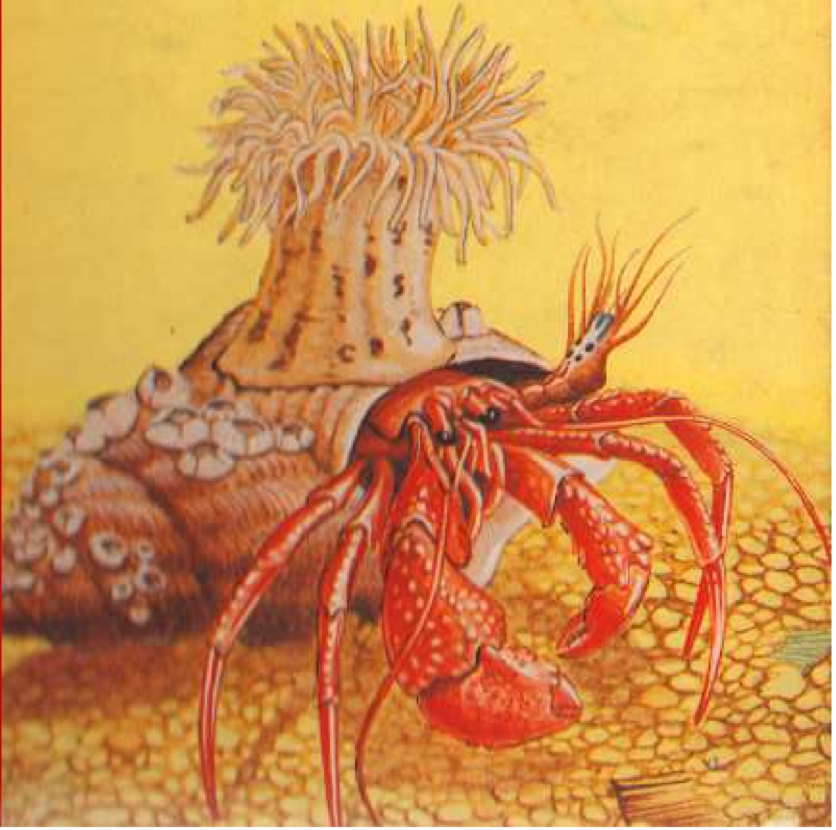
CONSERVATION

Understanding the sea



With every day that passes, a new discovery of some kind is made. Sometimes it is a new cure for a disease, sometimes it is a new star, sometimes it is a new element. We have explored the atmosphere of our own world, we have photographed far-distant planets, we have penetrated to the greatest depths of the ocean. Yet we know very little about the sea that covers nearly three-quarters of our planet. Here is a simple approach to a highly complex subject, with clear diagrams and illustrations.

Acknowledgments
Endpaper photograph and photograph on p. 43 by permission of Gillian Lythgoe, Seaphot Ltd; photograph on p. 49 by Patrick Thurston, by permission of the *Daily Telegraph;* and photograph on p. 51 by courtesy of *The Fish Farmer's Weekly*.

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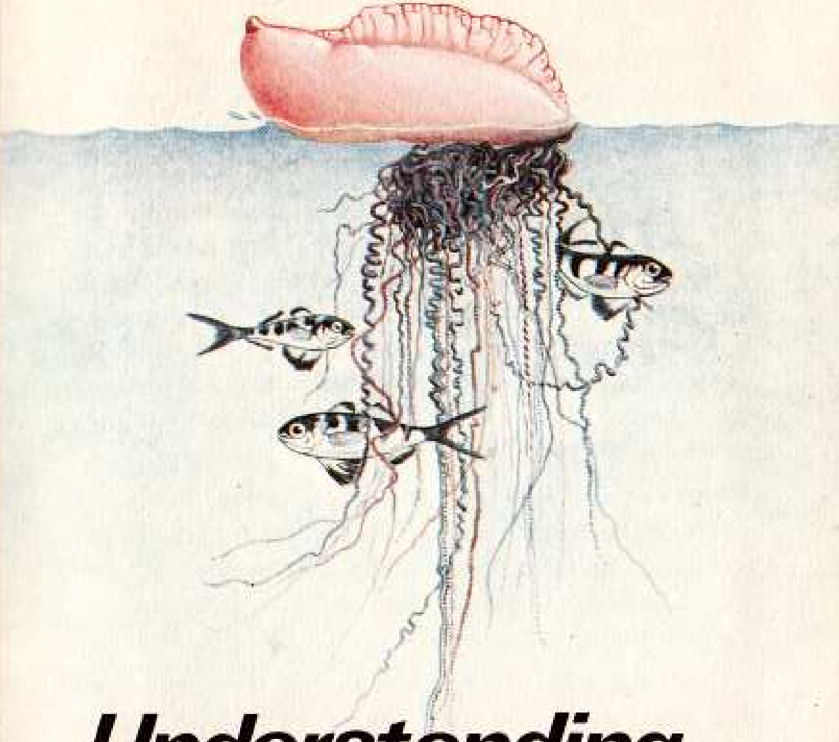


Understanding the sea

by Denis Sanderson

illustrated by Sean Milne

Ladybird Books Loughborough

EXPLORING THE SEA

A great era of exploration is now well under way. Men have reached the moon, and may soon be travelling to other planets. But did you know that almost three-quarters of our own planet is still unexplored?

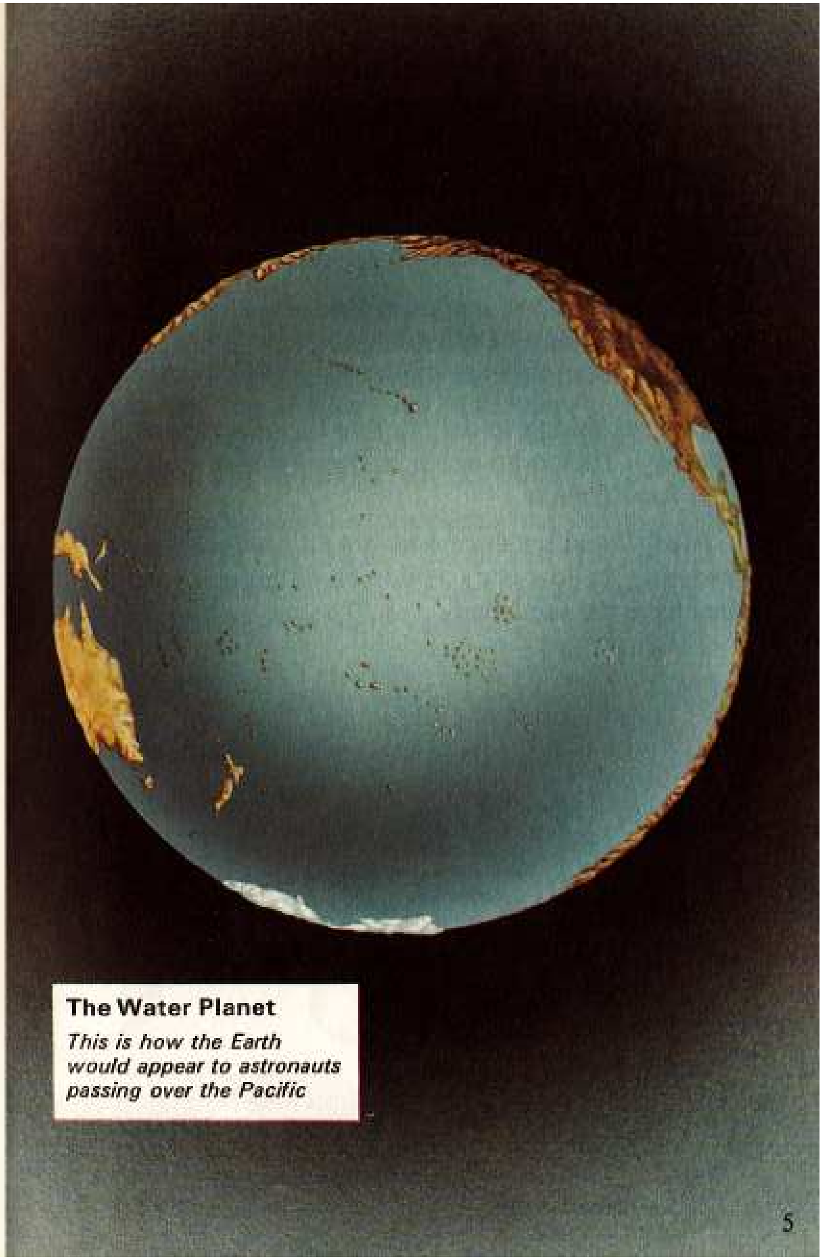
Nearly three-quarters of our world is covered by seas and oceans, and we are only just beginning to explore this world of the seas. In 1960, the bathyscaphe *Trieste* descended to 11,000 metres (35,800 ft.)—the bottom of the deepest part of the Pacific Ocean (the Mariana Trench, near the Philippine Islands) and the invention of the aqua-lung has enabled divers to begin exploring the more shallow parts of the sea.

However, it is not only in the deep oceans that new discoveries are being made. The shallow waters of the sea shore also offer opportunities for discovery. Much is still to be learnt about the lives and habits of many of the commonest sea creatures.

Every low tide on a rocky shore will reveal animals more strange than any to be found on land. Some have developed methods of hunting, killing and eating which no land animal has ever used.

It would be quite wrong to think that scientists have learnt all that there is to learn about these creatures, since there are too few scientists available for the study of the seashore.

This book will help you to make some discoveries of your own.



The Water Planet

This is how the Earth would appear to astronauts passing over the Pacific

ANIMAL LIFE OF THE SEA

All animal life can be classified into groups called phyla. One group is called a phylum, and all the animals in a single phylum have a basic similarity of pattern. All phyla are to be found in the sea, and ten of the most important ones are shown in the picture below.

The *Protozoa* are simple one-celled animals which can be seen only under a microscope. They are an important source of food for many larger creatures.

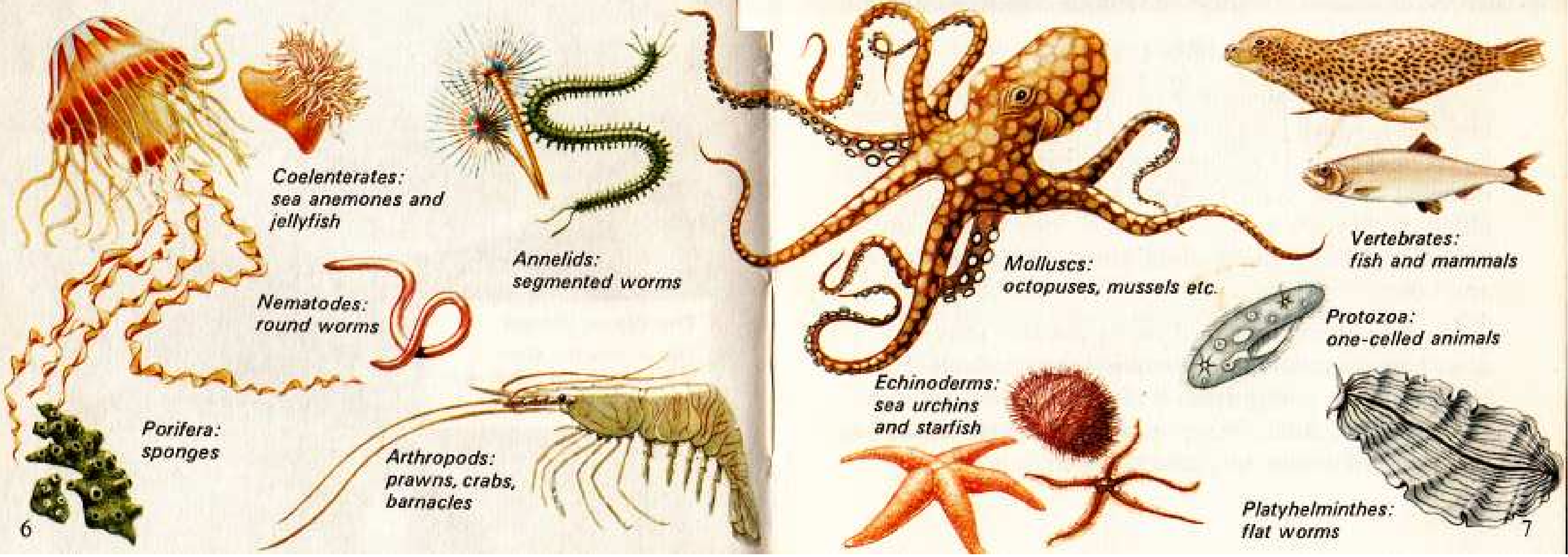
Sponges belong to the *Porifera* (meaning 'pore-bearing'). They draw water in through their pores and filter food from it.

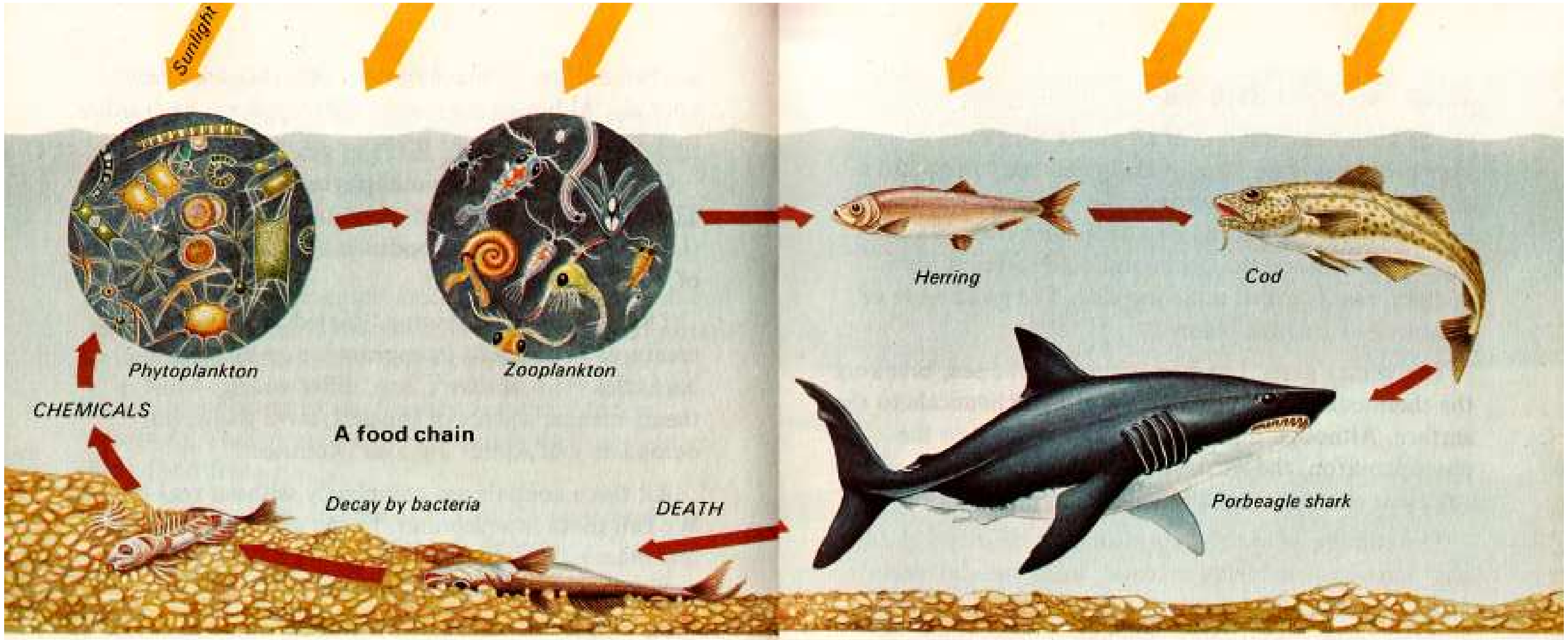
Jellyfish and sea anemones are all *Coelenterates* (meaning 'hollow gut'). Although differing in their habits, they have the same body plan. The sea-urchins and starfish are the *Echinoderms* or 'hedgehog-skinned' animals. Although they seem different from each other, they too have a similar plan.

Of the twenty-two animal phyla, ten are wormlike. The most important marine worms are the *Annelids* (Latin—'rings'), whose bodies are divided into a series of compartments.

The *Arthropods* (meaning 'jointed legs') include creatures as different in appearance as lobsters and barnacles. The *Molluscs*, too, differ widely. Most of them, such as whelks or mussels, have shells, but octopuses and squids are also Molluscs.

All these animals are completely without real bones. We call them *Invertebrates*. In the sea, only the fish, a few mammals, and some marine reptiles have true skeletons. They are the *Vertebrates*.




A food chain

PLANKTON AND FOOD CHAINS

Plankton is the name given to the microscopic animals and plants which drift in millions through the upper layers of the sea. (The name comes from a Greek word meaning 'wanderers'.) They are aptly named, for although they are unable to swim of their own accord, they may drift for hundreds of kilometres on the currents and tides.

The tiny plants are called *phytoplankton*. They live by absorbing chemicals from the sea. Like all plants they are able to use energy from sunlight in order to convert chemicals into food. This process is called *photosynthesis*. It is something that only plants can do.

The phytoplankton are eaten by tiny creatures called *zooplankton*. These in turn are the main food supply for many small fish like the herring. In their turn the herring are eaten by larger fish. This is called a *food chain*. Eventually it ends at a very large fish such as the shark. No other creature eats the shark.

When the shark dies its body decays and the chemicals from it are returned to the water. These are again absorbed by the phytoplankton and the chain starts again.

Without the phytoplankton's ability to absorb chemicals the chain would be incomplete, and no animal life would be able to exist in the sea. That is why these tiny plants are sometimes called 'the grass of the sea'.

SEASONS AND THE SEA

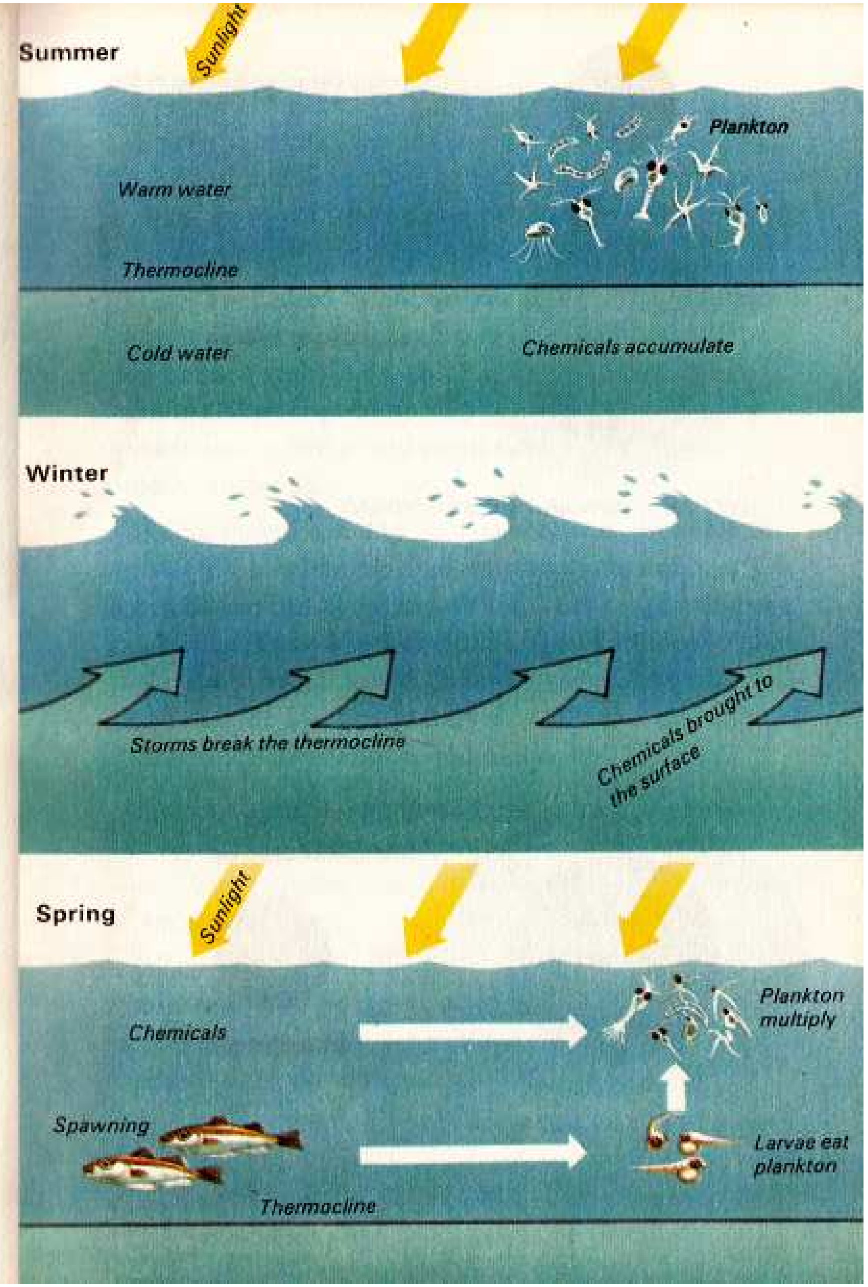
The countless millions of creatures which die every year provide a vast store of chemicals near the bottom of the sea. During the summer the water near the surface becomes warmed but the depths remain cold. The boundary between the warm and cold layers is quite distinct, and is called a *thermocline*. The great store of chemicals is trapped below it.

The winter gales, however, churn up the sea, breaking the thermocline and bringing the stored chemicals to the surface. Although this food is now available to the phytoplankton, the weak sunlight does not have sufficient energy to enable them to make use of it.

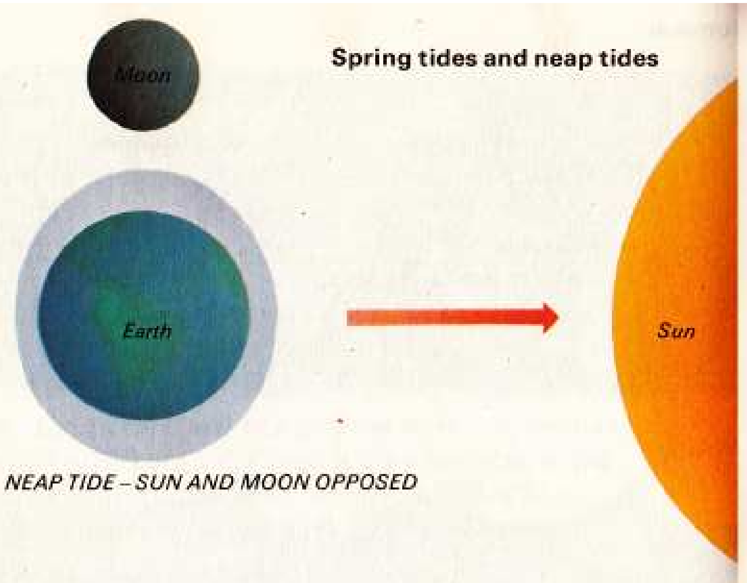
The coming of spring brings sunnier days and the phytoplankton suddenly increase, using the chemicals and sunlight. Fish and other creatures begin to spawn, and their young join the zooplankton in millions.

To take only one example, one turbot alone may lay anything from five to ten million eggs. The newly-hatched fish feed on the plankton nearby which, in consequence, is quickly used up, and by the end of spring has reached its lowest limit. Lacking food and falling prey to young jellyfish, crabs, etc., the millions of young turbot will have been reduced to about twenty.

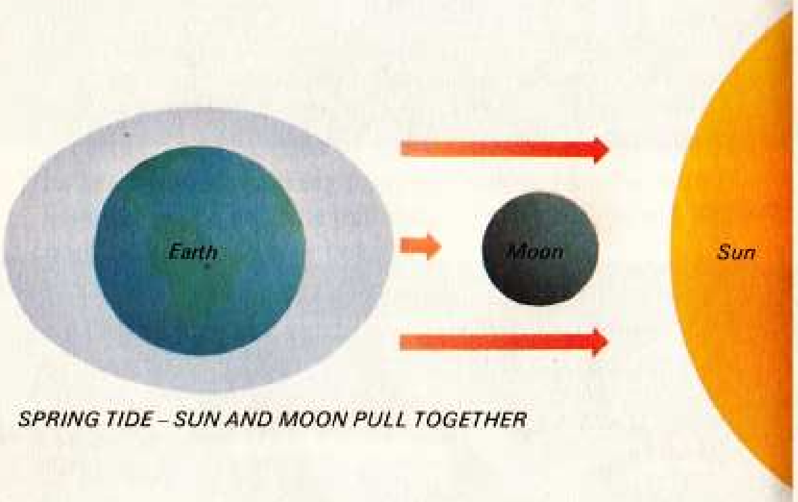
Summer comes, and the surface of the sea warms up again, trapping the nutritious chemicals below the thermocline, where they will remain stored until the winter gales (or currents such as the Humboldt Current off South America) bring them to the surface and the cycle begins again.



Spring tides and neap tides



NEAP TIDE – SUN AND MOON OPPOSED



SPRING TIDE – SUN AND MOON PULL TOGETHER

TIDES AND THE SEA SHORE

Strictly speaking, the sea shore is the area between the highest and lowest spring tides. Spring tides have nothing to do with the season of spring. In fact they are just exceptionally high and low tides.

Tides are caused by the gravitational pull of the sun and moon. When they both pull in the same direction they cause a *spring* tide which occurs about once a fortnight. (See opposite page.) When they are pulling against each other a very small tide occurs. This is called a *neap* tide.

Before planning a trip to the shore it is advisable to consult a tide-table. You can buy one at a stationer's or the tides may be given in your local newspaper. Choose a day when there is a spring tide. This will uncover parts of the shore which would be under water at any other tide. Near the low tide mark you will find a host of creatures which are not found higher up the shore.

Start by turning over some large stones. Underneath you are certain to find starfish and crabs of various kinds. You may find small fish like the blenny, butterfish or sea-scorpion.

When you have finished examining a rock, be sure to turn it right way up again, otherwise many small creatures which live on the underside will die when exposed to the air and sun.

ZONES OF THE SHORE – 1. PLANTS

The rise and fall of the tides makes the conditions on the higher parts of the shore quite different from those on the lower parts. This is because different parts of the shore are uncovered for different lengths of time. The highest levels are seldom covered by water and the lowest levels are seldom uncovered.

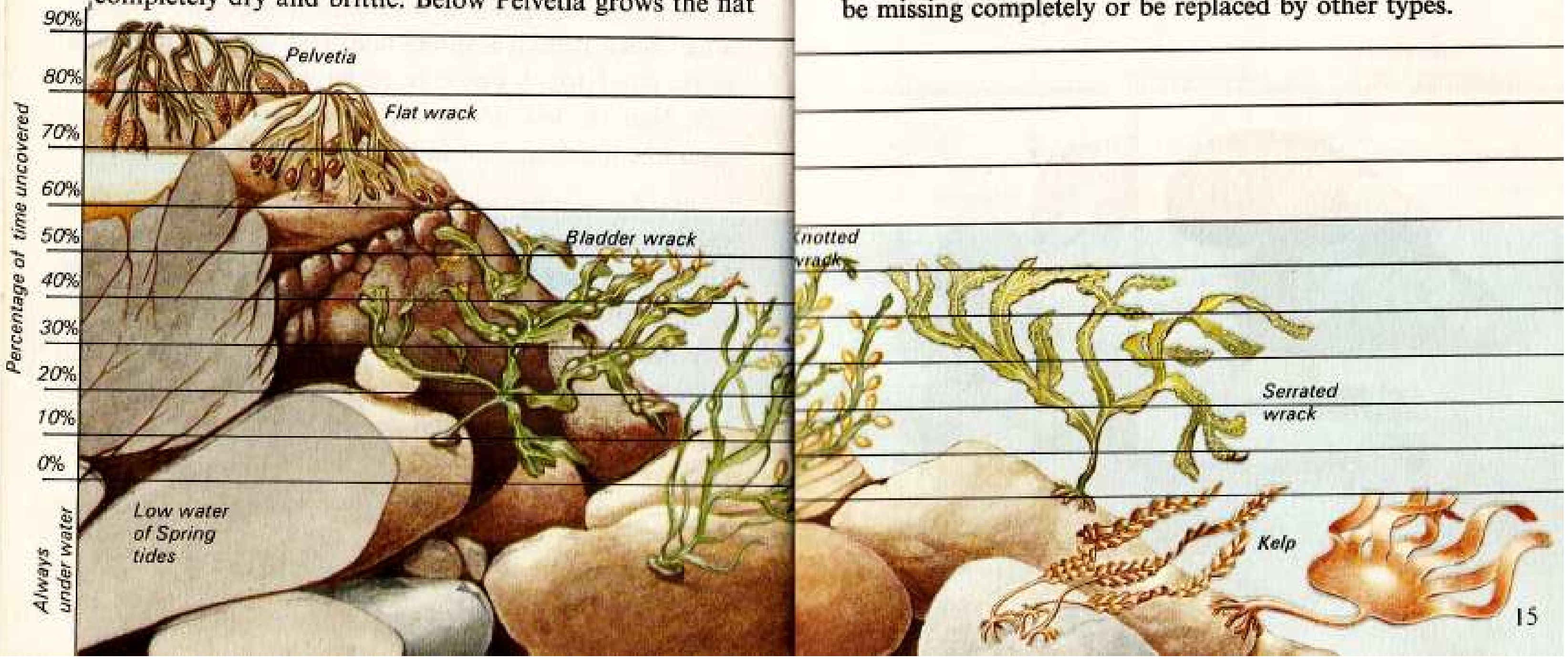
This has a great effect on the plants and animals at the various levels. Some can withstand a lot of drying-out, while other are very sensitive to it. The seaweeds are affected much more than most animals.

Near high-water mark there is usually a narrow belt of channelled wrack or *Pelvetia*. It spends from 70% to 90% of its time exposed to the air and is sometimes completely dry and brittle. Below Pelvetia grows the flat wrack which spends from 60% to 80% of its time uncovered.

The next zone is occupied by bladder wrack and knotted wrack, which are uncovered for 15% to 55% of the time. Overlapping these and extending far below them is the zone of the serrated wrack, which is exposed from 0% to 50% of the time.

Finally, below the low-water mark, come the biggest seaweeds – the kelp, which are not really shore plants but can grow down to a depth of 30 metres (32½ yds.). Some of them may be partly exposed at a very low spring tide.

Note These zones will not be found on every shore as local conditions vary a great deal. Some plants may be missing completely or be replaced by other types.



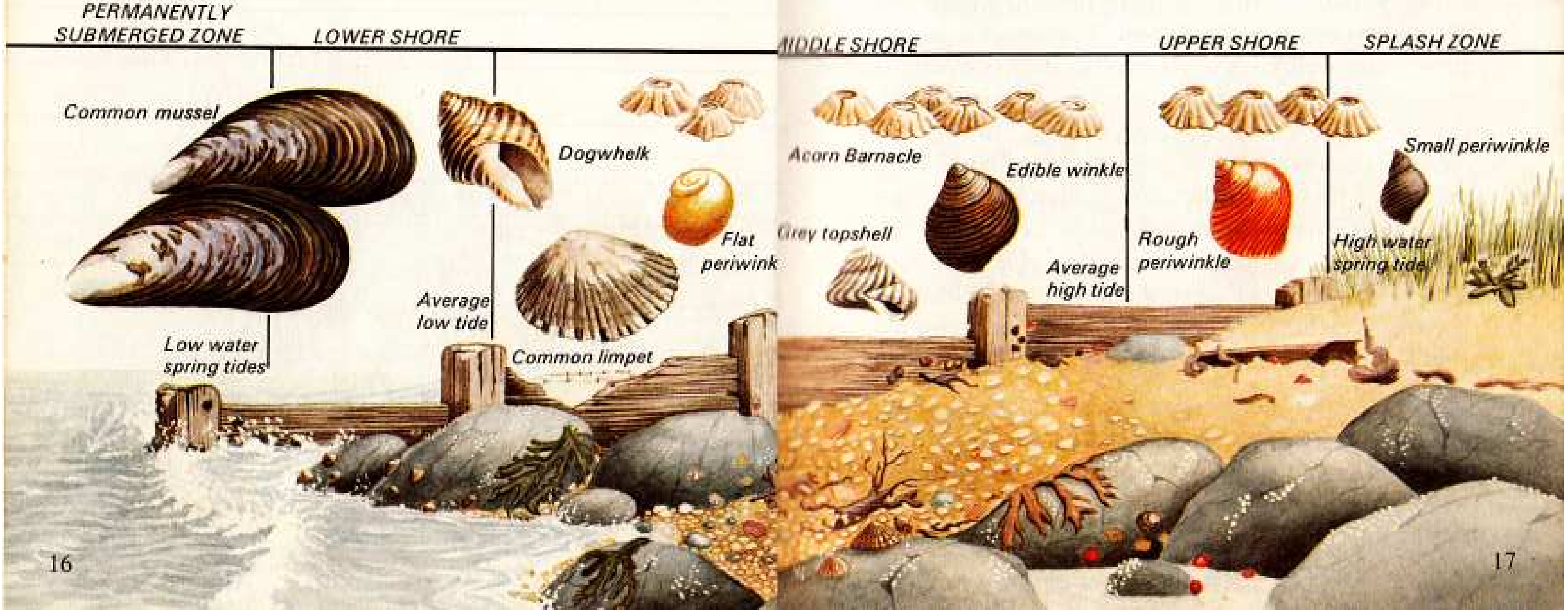
ZONES OF THE SHORE – 2. ANIMALS

Like the seaweeds, the animals of the shore are confined to certain zones. They too vary greatly in their ability to withstand exposure to the air. However, this is not the only factor which controls their distribution. Some, like barnacles and limpets, can live on exposed rocks which receive the full force of the breaking waves. Others, like the mussel, must live in a more sheltered area or they would be torn from the rocks by the waves.

Seaweeds, too, would be battered and broken if they grew in an exposed position, so they are mainly found in sheltered places. In very sheltered waters, such as those of some Scottish sea lochs, seaweeds completely cover the rocks. Where this occurs, barnacles and mussels would be 'smothered' by the weeds. They need to be exposed so that they can collect food from the water.

Barnacles live high up on the shore and some are even found in the splash zone above high-water mark. Mussels are found rather lower down. Sometimes they are separated from the barnacles and sometimes they overlap them. In this case the barnacles grow on the shells of the mussels. Sometimes on large boulders or cliffs, the lower limit of the barnacle zone can be seen as an almost perfect straight line.

The various periwinkles also inhabit particular zones, from the small periwinkle of the splash zone to the common and flat periwinkles of the middle and lower shore.



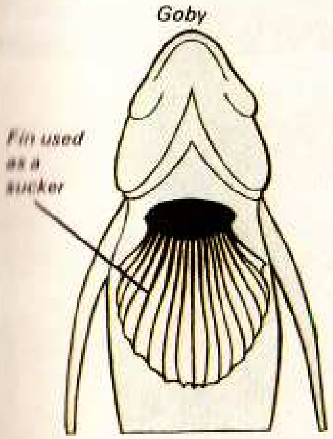
SURVIVAL ON A ROCKY SHORE

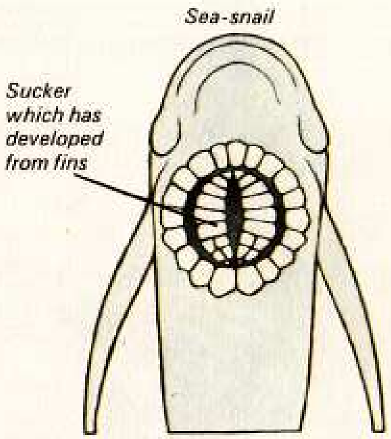
Quite apart from the dangers inherent in temperature changes, animals living on a rocky shore risk being battered to death by the waves every time the tide comes in. When it goes out again they are in danger of being dried up by the sun and wind. They overcome this double problem in many different ways.

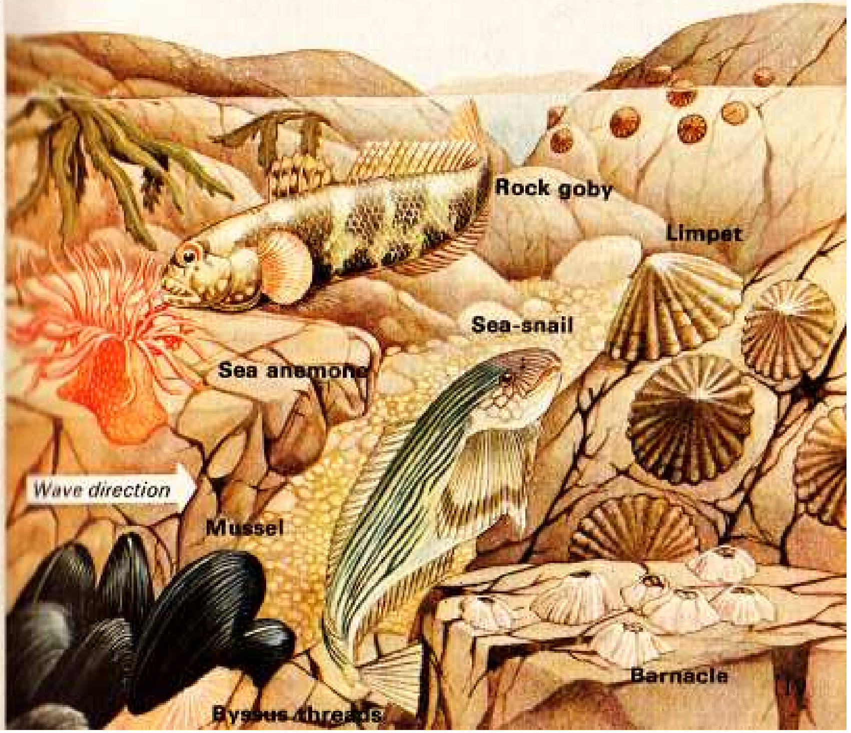
The common blenny and the butterfish wriggle into crevices or hide under boulders. Crabs protect themselves by 'digging in'. They burrow down into the shingle and hide underneath stones. If one of their legs gets trapped under a rock, they can break it off and eventually grow a new one. Starfish, too, have this ability to shed trapped limbs and grow new ones.

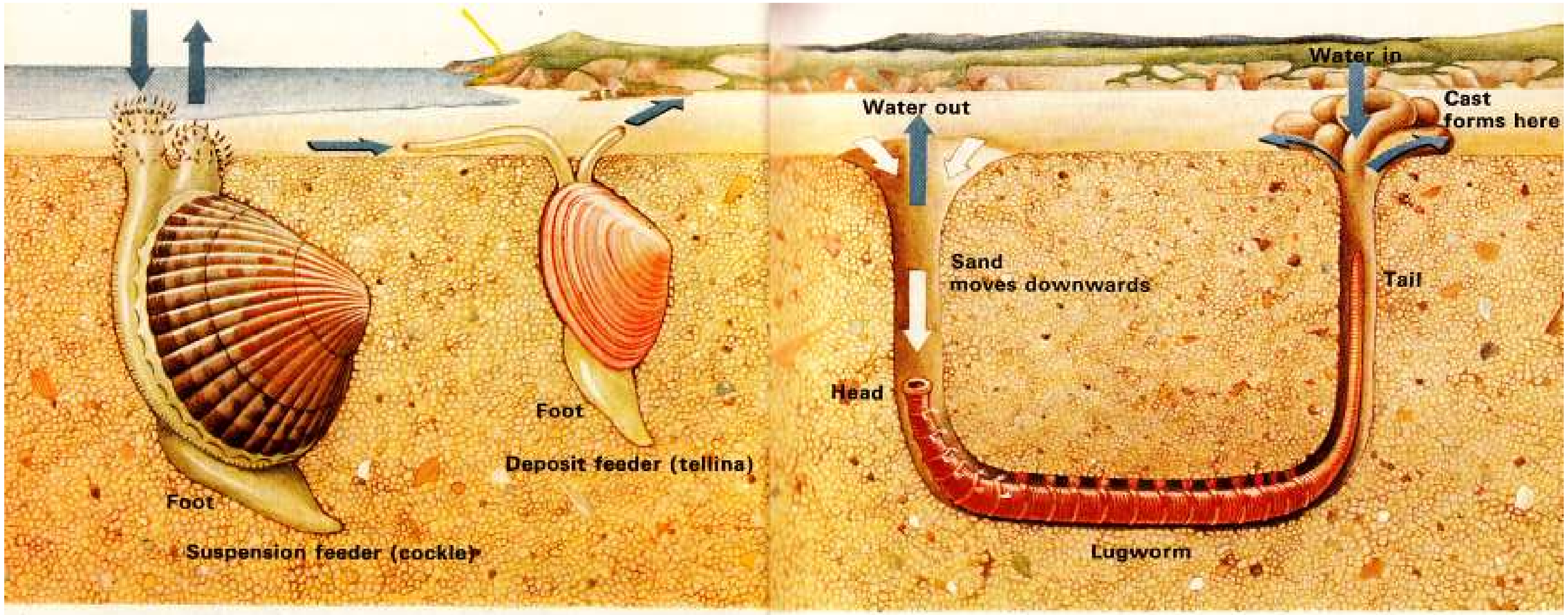
Many animals cling tightly to the rocks to prevent themselves being washed away. The limpet's gripping powers are well known. Its conical shell is ideally shaped to withstand the shock of the waves. Barnacles and some tube worms are permanently 'cemented' to the rocks. Mussels, however, attach themselves by means of anchoring threads. If these are broken they can make new ones. They avoid drying-out by keeping their shells tightly closed. Common periwinkles 'glue' themselves temporarily to rocks when the tide is out. If the returning water washes them off, they can be rolled about like pebbles in their thick round shells.

Some fish have developed suckers by which they attach themselves to rocks. The Cornish sucker, lumpsucker and sea-snail have suckers, but the rock goby has a joined pair of fins which act as a sucker.









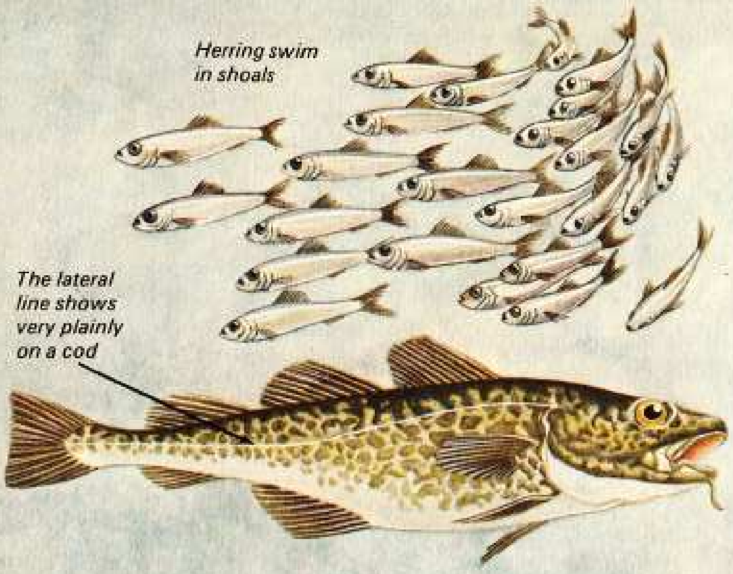
SURVIVAL ON A SANDY SHORE

Nothing could be more different from a rocky shore than an open sandy beach. Here there are no stones or seaweeds to shelter the animals. They have only one safe place to go, and that is into the sand. Just as many animals have developed special varieties to survive the conditions found on rocky shores, so have they special forms which burrow in sand. There are burrowing starfish and burrowing urchins called heart-urchins or sea-potatoes.

The shrimp is a burrowing relative of the common prawn which is seen in rock pools. The shrimp's body is more flattened and it has more powerful pincers. It lacks the pointed rostrum which prawns have between their eyes.

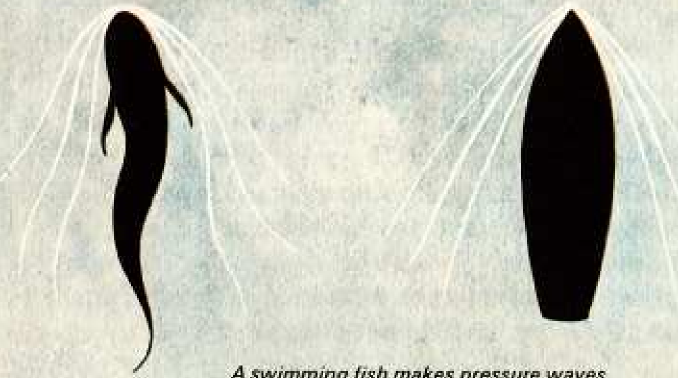
In some ways these sand-dwellers have a safer life than their relatives on rocky shores. At low tide the sand holds water below the surface. Its temperature remains steady whatever the weather and fresh rain-water cannot penetrate more than 25 cm (10 in) below the surface.

The sand-dwellers find their food in four different ways. Suspension feeders like the common cockle filter phytoplankton from the water. Deposit feeders suck up food from the surface of the sand. The lugworm actually eats the sand and obtains nourishment from it. Lastly come predatory animals which include crabs and fish. The masked crab remains below the sand breathing through a 'snorkel' tube formed by its long antennae, and rarely appears above the extreme low-water mark.



Herring swim in shoals

The lateral line shows very plainly on a cod



A swimming fish makes pressure waves rather like the wash from a ship

SURVIVAL IN THE OPEN SEA

We have seen how animals protect themselves on rocky and sandy shores, but how can small fish survive in the open sea where there is nowhere to hide at all?

Firstly, fish which swim near the surface are just as well camouflaged as those which live on sand or rocks. They are usually blue or grey on their backs and silvery-white below. The blue-grey colour is an ideal protection against sea-birds flying overhead. It matches the colour of the sea as it appears from above.

The surface of the sea is a completely different colour when seen from below. A diver sees the sea's surface as a bright silvery canopy overhead. The silver colour of small fish is ideal protection from enemies lurking below.

Most fish of the open sea gather into shoals which helps to protect them. This discourages smaller attackers and prevents the fish from being spread over a wide area where they would be more easily found. The war-time convoys worked on exactly the same principle.

Shoaling fish can swim in formation and turn together like soldiers on parade. It is thought that they are helped in this by their lateral lines, which pick up vibrations and pressure waves caused by the movements of surrounding fish. The lateral line which runs along each side of the fish is actually a row of pores leading to nerves which in turn lead to the brain.

THE SALTY SEA

Seawater is not just a mixture of salt and water. In fact the sea contains nearly all the known elements. For example five million litres (1 million gallons) of seawater contain about 0.01 grams of gold – worth only a fraction of a penny.

How did these minerals get into the sea? Many of them come from the rocks on the sea-bed. Others have been washed down from the land by rivers over millions of years. The seas have been gradually getting saltier ever since they were first formed. At present most seawater is about 3.5% salt.

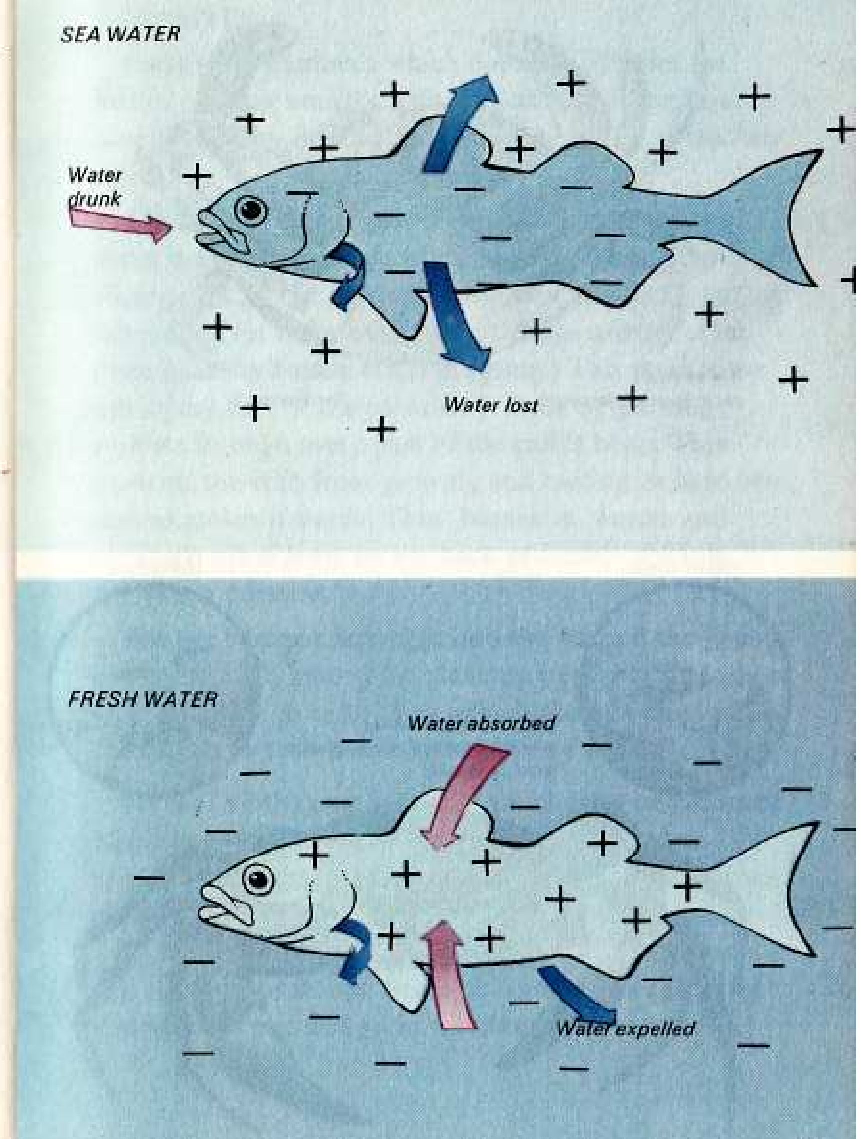
We know that the prehistoric seas were much less salty because the body fluids of fish, which have evolved in the sea, are less salty than the surrounding water. In other words, the seas have grown more salty but the fish have not.

Because their body fluid is less salty than the sea, fish are continually losing water through their skin and gills. (Water always moves from a weak solution to a stronger one.) To make up for this loss they must keep drinking water. Salt cells on the gills of seafish extract the excess salt taken in with the seawater.

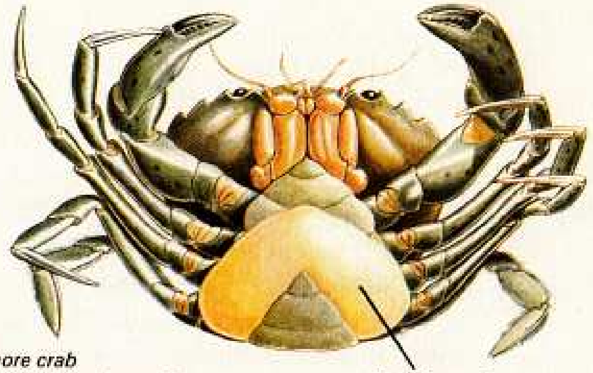
Freshwater fish have the opposite problem. Their body fluids are stronger than the surrounding water and so they are continually soaking up extra water. They have to get rid of this water and so they do not drink.

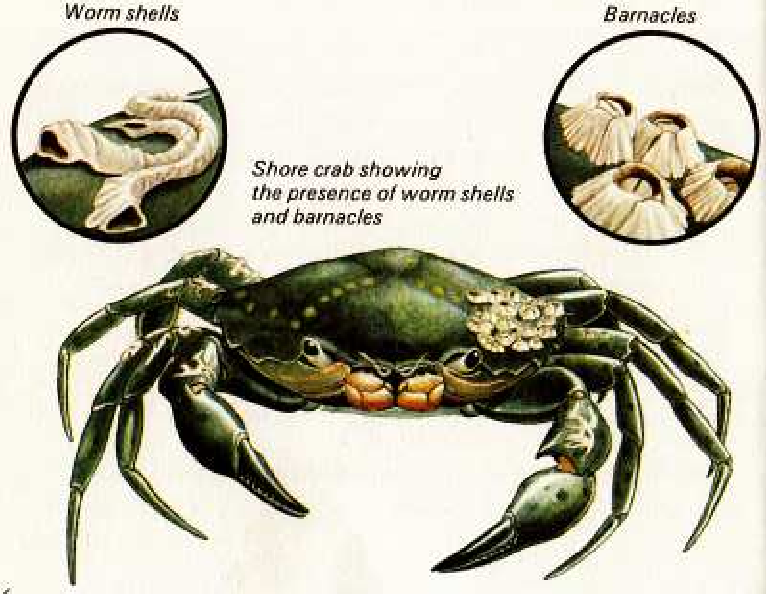
This is why seafish cannot live in fresh water, though some, like the salmon, are capable of migrating from the sea to the rivers.

Water balance in fish



Sac Barnacle on a shore crab





PARASITES

Parasites are animals which obtain food from the bodies of other animals without actually killing them. Sometimes they do this by sucking the blood of the *host* animal.

The most likely parasite to be encountered on the shore is the sac barnacle which lives on the underside of shore crabs. It is a bright yellow mass under the 'tail' of the crab. (Not to be confused with eggs carried in the same place by female crabs in spring.) This mass is the egg-laying part of the parasite. It feeds by growing rootlets through every part of the crab's body. This prevents the crab from growing and casting its hard skin, and so makes it sterile. Thus, barnacles, worms and seaweeds often grow on the back of a crab which is carrying a parasite.

The sac barnacle lays eggs into the sea and the young live temporarily among the plankton until they find a host crab on which to settle. It is only at the plankton stage that it can be seen that they really are barnacles.

On the Welsh coast is a leech which lives on common blennies. It is found inside the gill chambers when young, and attached behind the large pectoral fins when adult. The adult leech is about 1 centimetre (less than ½ in) long. In April these adults leave their hosts and lay egg cocoons on stones. Seven or eight months later the young hatch out and go in search of their own hosts.

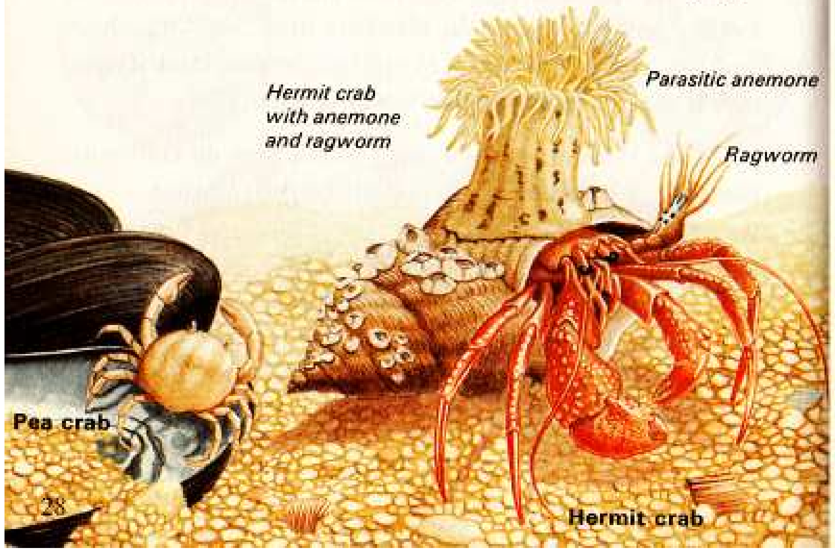
LIVING TOGETHER

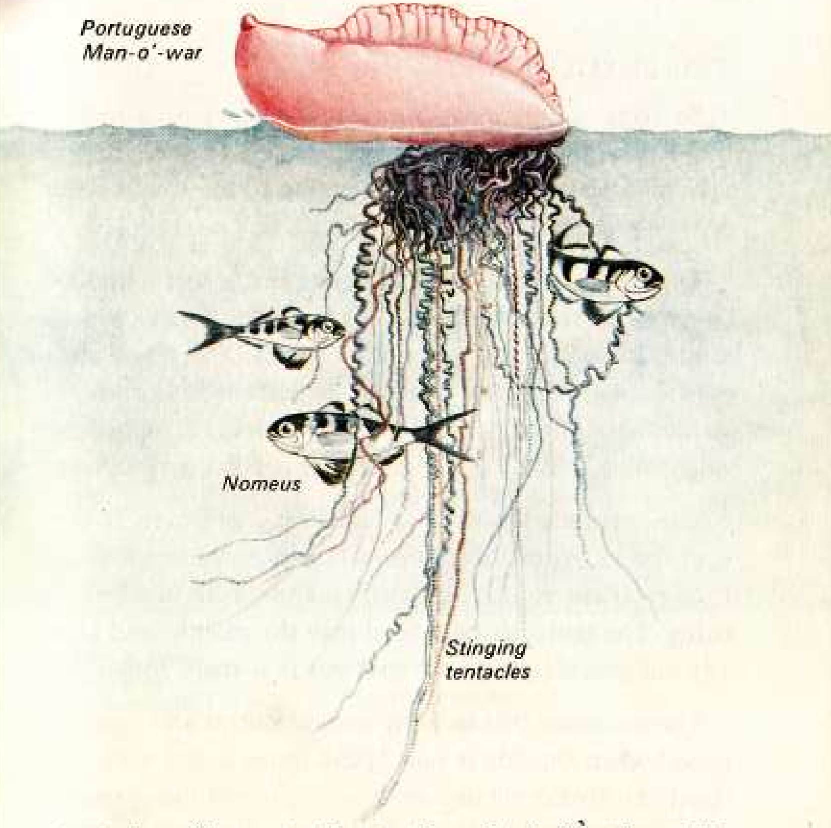
Sometimes two animals live together without causing each other any harm. Barnacles may live on the back of a large shore crab or mollusc shell, or even on the tough skin of a whale.

Being transported around by the whale, they are able to get more food. Of course, barnacles living on an anchored shell, e.g. mussel or oyster, gain no extra food. Those living on a crab may even get less, as crabs have a habit of hiding in holes and under stones.

On the shore small pea crabs live inside the shells of large mussels, where they gain protection. They remove food from the gills of the mussel and may even eat the soft gill tissue, so they are partly parasitic.

Large hermit crabs which live in cast-off whelk shells may carry sponges, hydroids or tube worms on their shells. Often they carry an anemone which collects 'left-overs' of food. In return the anemone's stinging tentacles offer protection to the crab. Inside the crab's shell may be a ragworm which also shares in the food. In return it keeps the inside of the shell clean, and its movements cause a flow of water around the crab's body.





In the open sea lives the Portuguese man-o'-war, a large and dangerous jellyfish. Amongst its stinging tentacles lives a small fish called *Nomeus* which, being immune to the stings, gains protection amongst them. Nomeus attracts other fish which are killed and eaten.

THE BEADLET ANEMONE

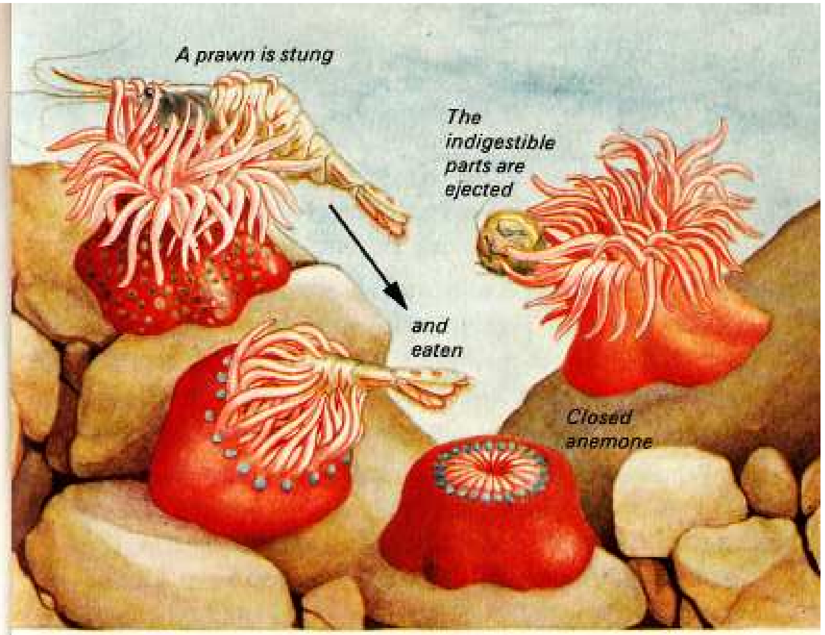
Beadlets are the most common anemones on a rocky shore. You may find red, brown, orange or green varieties. They are animals belonging to the Coelenterate phylum, which also includes jellyfish and corals.

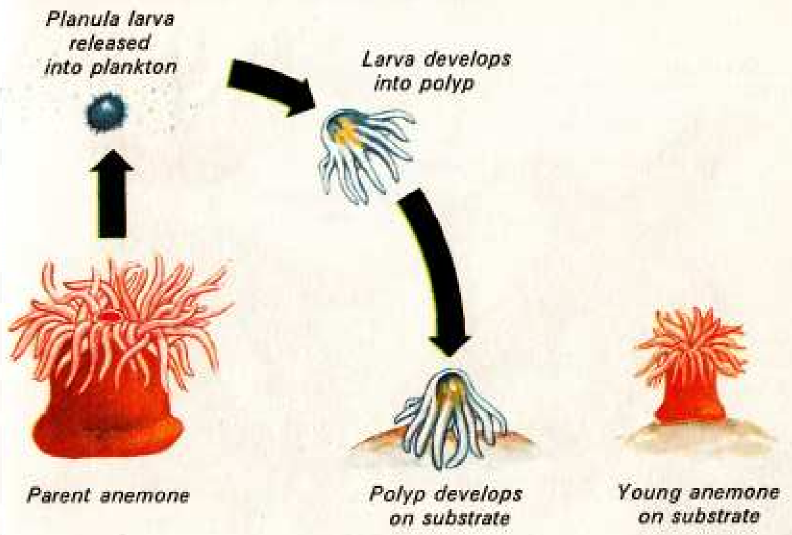
The beadlet's body has no bones, but is just a hollow bag with a mouth and a ring of tentacles. These tentacles are covered with stinging cells. The stings are released automatically whenever a tentacle is touched. At the base of the outer ring of tentacles is a ring of bright blue 'beads', from which the beadlet gets its name.

The anemone has no eyes and so it cannot see. It must wait for some small creature to touch its tentacles and trigger off the stings. These stings cannot harm a human being. The tentacles pass food into the mouth, and later any indigestible pieces are spat out in a small round ball.

The anemone fills its body with seawater and remains closed when the tide is out. It can move about very slowly by stretching and contracting rather like a snail. The eggs of the female are fertilised in her body cavity, then the embryo is released through the mouth and forms a *planula* larva in the plankton. They remain in the plankton for a time, then settle on a rock and begin to grow.

If an anemone is damaged or broken in half, it can heal and grow into two separate anemones.




Planula larva released into plankton
Larva develops into polyp
Parent anemone
Polyp develops on substrate
Young anemone on substrate

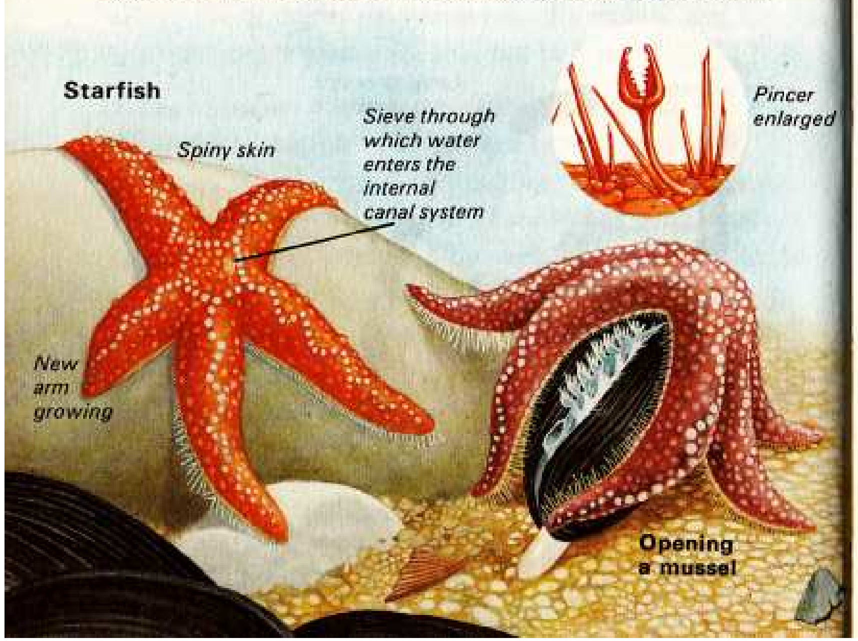
THE COMMON STARFISH

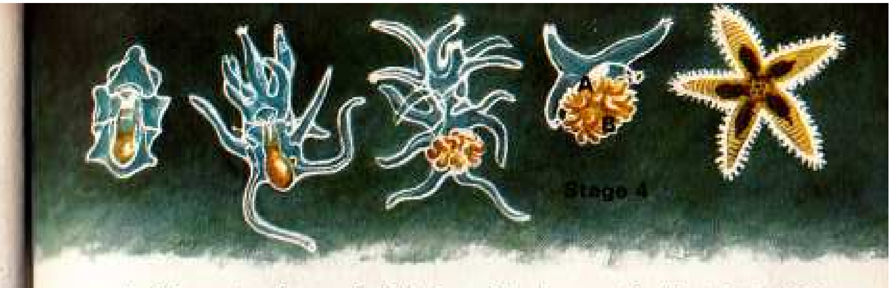
The starfish is an Echinoderm or 'hedgehog-skinned' animal related to the sea-urchin. Both have spiny skins and the same radiating body plan. The starfish's skin is covered with small spines and pincers. The pincers keep the skin clean by removing rubbish from it.

On the underside of a starfish are many small legs called tube feet. These give it a very powerful suction grip and it can even climb the glass of an aquarium. The tube feet are filled with water which comes in through a sieve on its back near the junction of two of its arms.

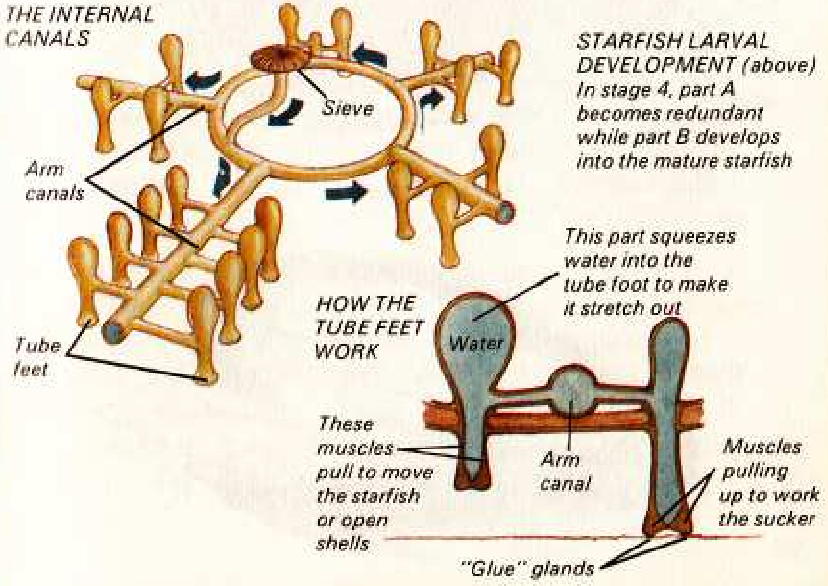
When water is squeezed into the tube feet they stretch lengthways until they touch a hard surface which they can grip. In order to get their powerful grip, some muscles pull upwards upon the centre of each suction disc and the water pressure on the outside holds them tightly onto the rock. This works in exactly the same way as air pressure holds a rubber sucker onto a glass window. However, the starfish also has its own 'glue' which is made by glands under its suckers.

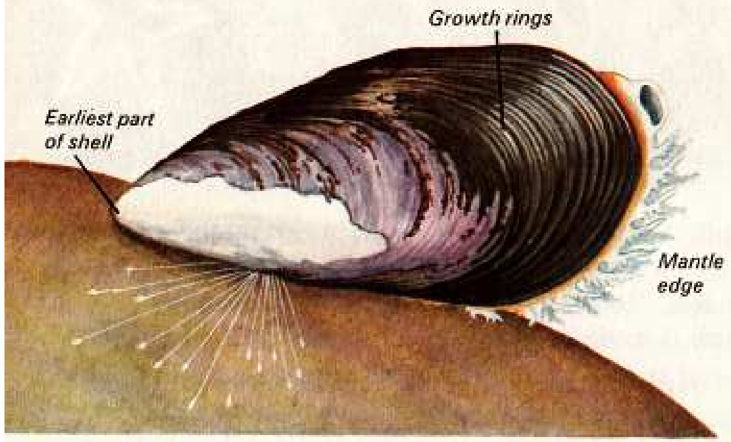
Armed with these gripping feet the starfish can pull open the mussels and oysters on which it feeds. (Starfish are pests of oysterbeds.) It eats by putting its stomach out through its mouth and digesting the food externally. If one arm becomes trapped the starfish will break it off and eventually grow a new one. Even one arm can grow into a new starfish.



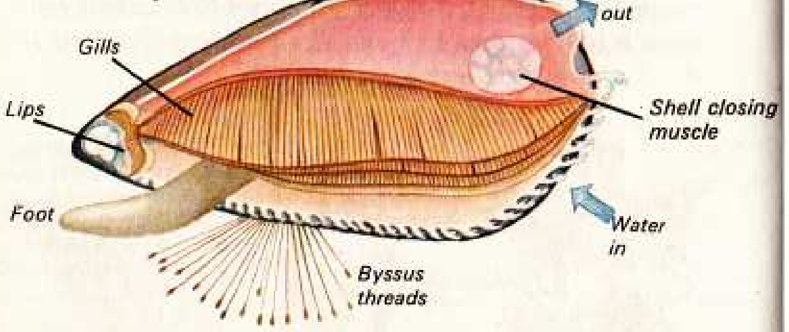


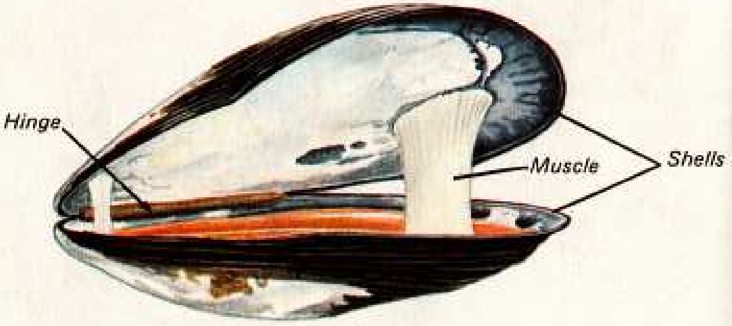
STARFISH LARVAL DEVELOPMENT (above)
In stage 4, part A becomes redundant while part B develops into the mature starfish


THE INTERNAL CANALS
Sieve
Arm canals
Tube feet
HOW THE TUBE FEET WORK
This part squeezes water into the tube foot to make it stretch out
Water
These muscles pull to move the starfish or open shells
Arm canal
Muscles pulling up to work the sucker
"Glue" glands



INTERIOR
Section through mussel





THE MUSSEL

Mussels usually live crowded together on rocks and stones, where they are fastened by tough cords called byssus threads. They are not anchored permanently but can move by means of a muscular foot which comes out between the two shells.

Because it has two shells the mussel is called a *bi*-valve. (Molluscs with only one shell are called *uni*valves.) These two shells are lined with a soft white mantle which has brown frilly edges. Under water the shells open slightly and the frilly edge comes out. At the blunt back end of the animal the mantle forms two openings; water is pumped in through one and out through the other. Inside the shell the water passes through gills which extract oxygen and, even more important, sieve out very small food particles in the current. From the gills, two lip-like flaps pass the food into the mussel's mouth.

The shells are pulled together by a powerful muscle which runs between them. The springiness of the hinge between the shells pulls them open when the closing muscle is relaxed. The mussel is, however, no match for a starfish, though a long struggle may take place before the mussel finally weakens and its shells are pulled open.

The shells themselves have three layers – a thin coloured layer on the outside, a thick white layer of lime and a thin pearly lining. The shells are manufactured by the mantle. On the outside are growth rings showing the age of the shell. When an empty shell is found with a small hole bored through it, this hole has been made by the dog-whelk, another of the mussel's enemies.

PRAWNS

Prawns are very plentiful in rock pools during the spring and summer. In winter they migrate into deeper water where the temperature remains more nearly constant than on the shore.

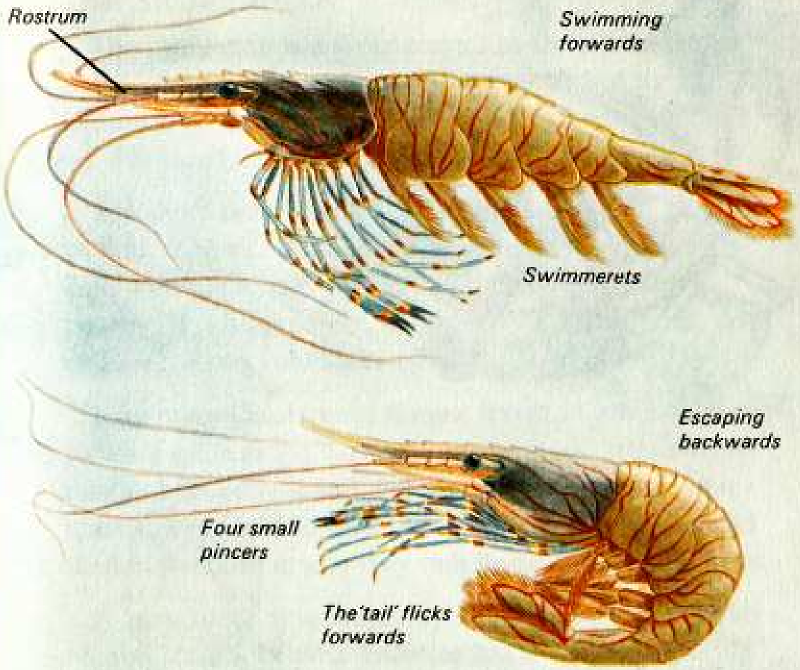
It is difficult to see a prawn in the water because it is almost transparent. It can be found hiding among weeds or walking on the bottom of a pool on its six long walking legs. It has four more legs at the front which have small pincers. It also has four antennae which help it to locate food.

When alarmed the prawn shoots backwards out of danger. It does this with a sharp snap of its fan-like tail. To swim forwards it uses swimmerets under its abdomen. These paddle rapidly to move it through the water. They are also used by the female to carry eggs.

The prawn is a *Crustacean:* it has a hard external skeleton like the lobster and the crab. In order to grow it must moult because the hard skeleton cannot grow. It takes only half a minute for the prawn to cast off the old skeleton, but it must wait two days for the new one to harden.

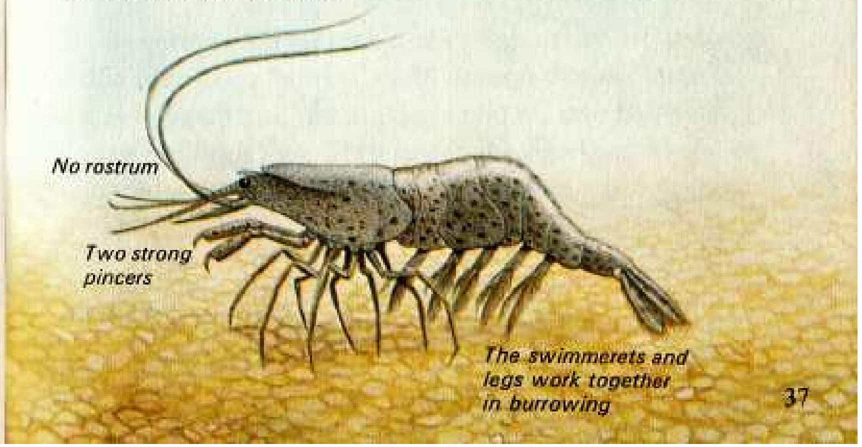
Prawns are scavengers which eat any bits and pieces found on the bottom of rock pools. They are very particular about their personal cleanliness. A prawn will clean its antennae, legs and swimmerets very carefully. The tail is pulled forward between the legs so that it can be cleaned.

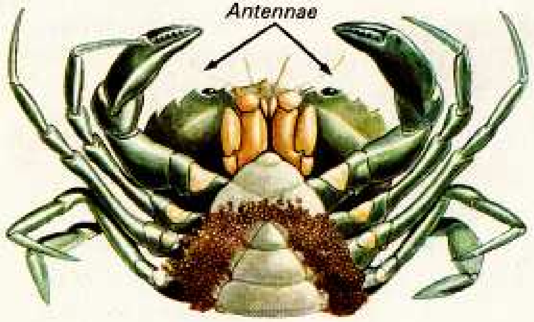
Prawns

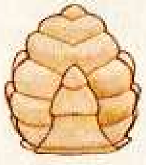


A Shrimp

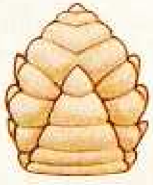
Compare this with the prawns


No rostrum
Two strong pincers
The swimmerets and legs work together in burrowing



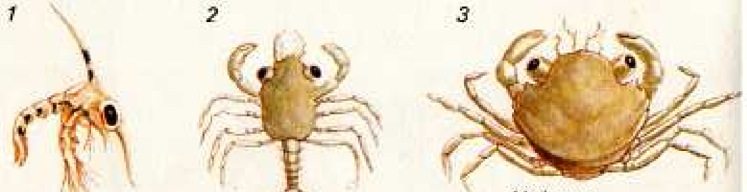


Male – narrow abdomen



Female – wide abdomen

LARVAE



Abdomen becomes folded under

THE SHORE CRAB

The shore crab is a Crustacean like the prawn. It has the same body plan as a prawn or lobster but its abdomen or 'tail' is folded flat under its body. You will see this clearly if you turn a crab over.

The shore crab is usually green or brown, but it may be almost black. It is easy to distinguish from the edible crab which is orange-brown with broad black-tipped pincers. It is a scavenger, eating other sea creatures, dead or alive, or any rubbish it can find.

Like other Crustaceans it must moult in order to grow. Its shell splits at the back and the crab struggles out. At this time its body is soft and its claws are useless, so it must hide or it would soon be killed. Upon leaving the old shell it increases in size very rapidly by soaking up water.

A crab which gets caught by one leg can break the leg off and leave it behind. Each leg has a definite breaking point and a special muscle to snap it off. A new leg starts to grow at the next moult.

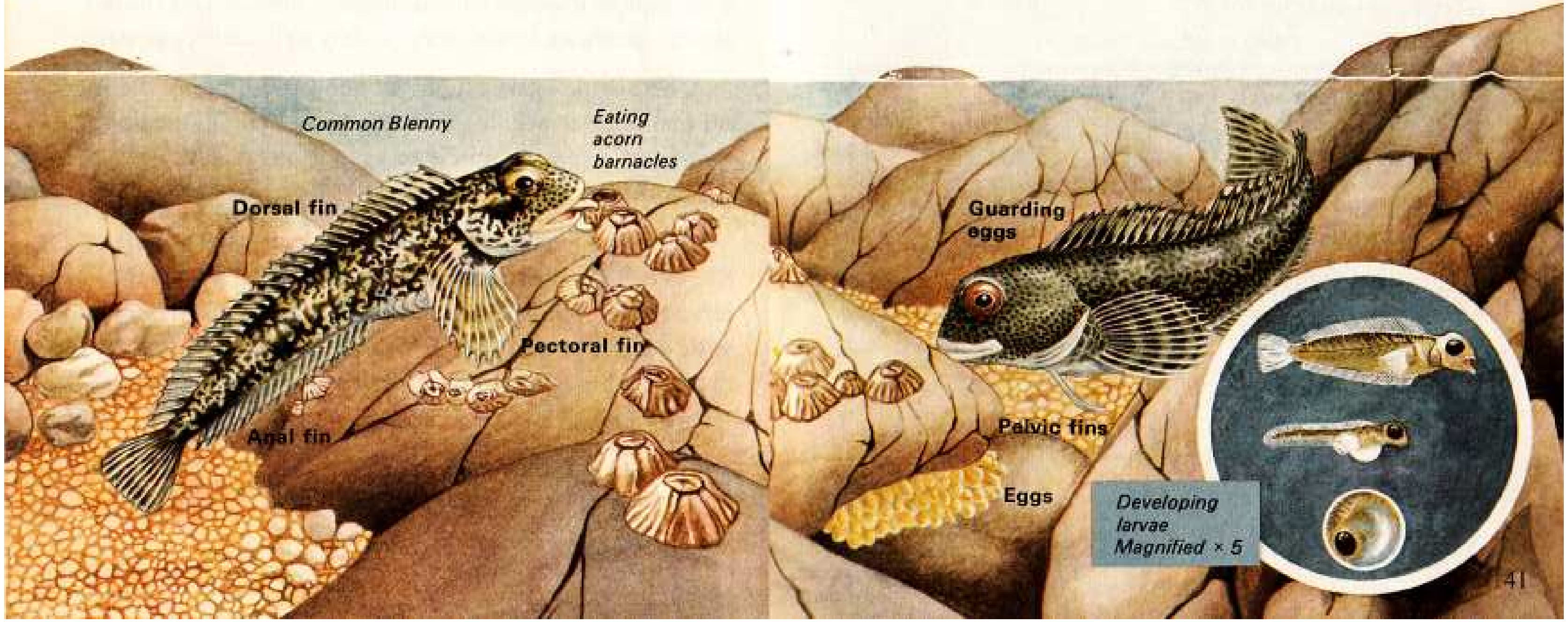
In spring a female crab carries eggs under her abdomen. She is called a 'berried' crab. Several months later the larvae hatch and she brushes them off into the water with her back legs. They live in the plankton where, by moulting, they change through three stages to become true crabs.

THE COMMON BLENNY

The blenny is the commonest fish on a rocky shore, and probably the best adapted to survive in a region which is constantly alternating between air and water.

It is usually a greenish colour with darker spots and patches. It has a smooth skin with no scales. Along its back is a long fin called the dorsal fin and on either side of its head are two large fins called pectoral fins. When the tide is out it uses these fins to skip over stones and wriggle into crevices. It can live for several hours out of water as long as it keeps moist. Its large eyes are almost on the top of its head and can move independently of each other. It has powerful teeth and jaws which enable it to bite barnacles off the rocks.

In June the female lays a row of bright yellow eggs under a stone. She then leaves them for the male to look after. He turns almost black and his large lips turn white. This makes him look fierce as he keeps guard over the eggs, chasing away any other fish that come near. When the larvae hatch they join the plankton where they feed on smaller creatures. Gradually they change, until by the time they are three months old they look like fish.

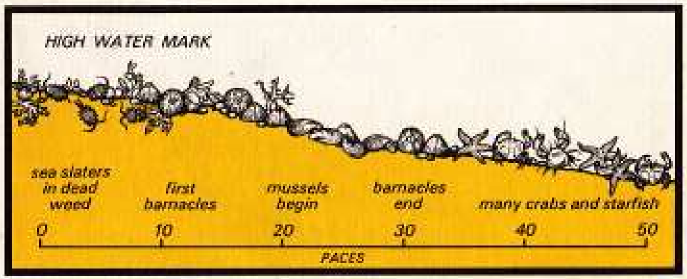


SOME THINGS TO DO

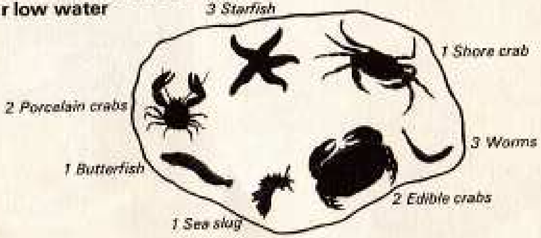
When you visit the sea shore it will be much more interesting if you can make some discoveries yourself. No two shores are exactly alike, so this is not as impossible as it may seem. Animals and plants which are found on one shore may be completely missing from another. Perhaps you will be able to think of reasons for this.

We have already seen that life on the shore is restricted to definite zones. Take a notebook and pencil and start from the high water mark when the tide is out. Work in a straight line down to the sea and make a note of every kind of animal and plant you find and where you found it. Notice whether there are large zones of barnacles, mussels or a particular sea-weed. Note where they begin and end.

Rocky beach at Rhos-on-Sea



Animals under one rock near low water



Try counting the number of animals in a square metre at different points on the shore. Examine the life amongst pebbles, stones, boulders and on a cliff if possible. Make a list of the animals which live on and under one rock near low water. You will have to be quick to catch some of them when you turn the rock over. Don't forget to turn it back again!

Can you discover whether shore animals live in particular 'homes' or just wander about the shore? A large crab in an easily-marked place would be a good animal to start with.

SEAWATER AND BREATHING

You may want to take a few creatures home to study more closely, but it is not a good idea to try this unless you live close to the sea. Sea fish will not live for very long in a bucket, unless the water is frequently changed, or aerated by an aquarium pump.

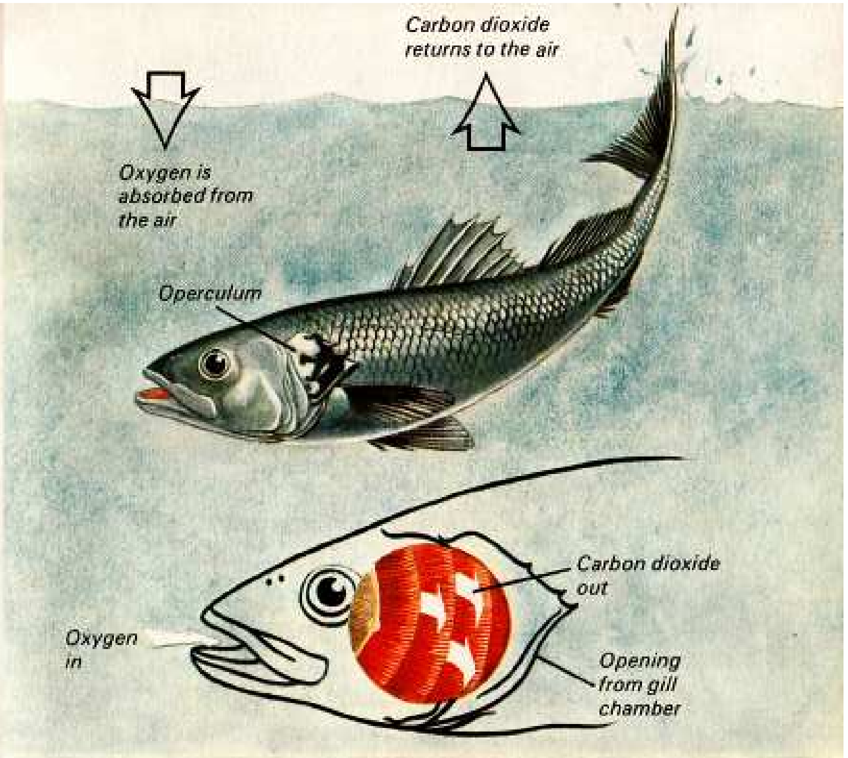
It is best to get the widest container that you possibly can. Put in it only two or three small fish with about 3 or 4 cm (1½–2 in) of water. No more is necessary! To understand why, you must know something about how a fish breathes.

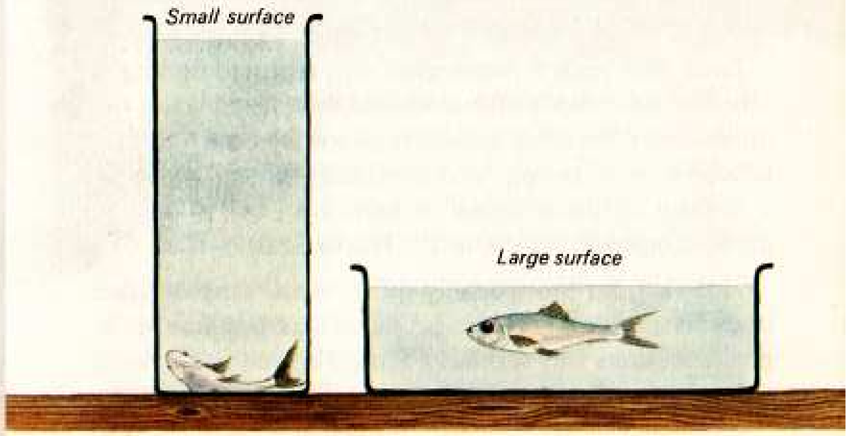
The fish sucks in water, closes its mouth, then forces it out over the gills. The gills take oxygen from the water and give out carbon-dioxide.

The water surface in the container also acts like a gill. It absorbs more oxygen from the air and gives off carbon-dioxide. Thus the surface area of the water is more important than the actual amount.

This could be proved by pouring equal amounts of water into a tall narrow jar and a wide washing-up bowl. A fish would live for a long time in the wide bowl but it would soon die in the narrow jar if you left it there.

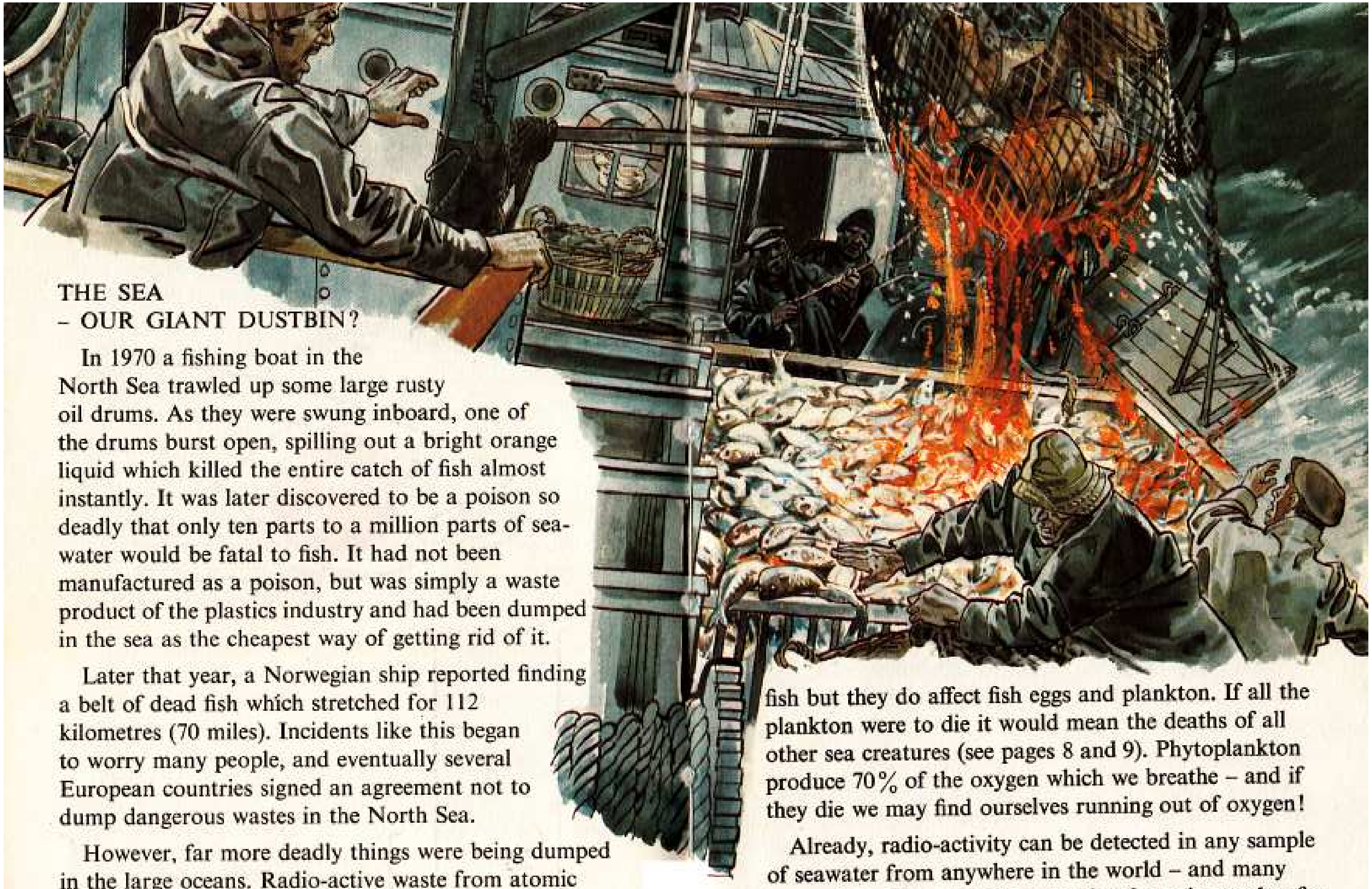
Seawater can only hold four-fifths as much oxygen as fresh water, so it is important to put only a very few creatures in your container. Cold water can also hold more oxygen than warm water, so try to keep your container in the shade and never leave it in the sun.


Carbon dioxide returns to the air
Oxygen is absorbed from the air
Operculum
Carbon dioxide out
Oxygen in
Opening from gill chamber



Fish dies

Fish lives



THE SEA
– OUR GIANT DUSTBIN?

In 1970 a fishing boat in the North Sea trawled up some large rusty oil drums. As they were swung inboard, one of the drums burst open, spilling out a bright orange liquid which killed the entire catch of fish almost instantly. It was later discovered to be a poison so deadly that only ten parts to a million parts of sea-water would be fatal to fish. It had not been manufactured as a poison, but was simply a waste product of the plastics industry and had been dumped in the sea as the cheapest way of getting rid of it.

Later that year, a Norwegian ship reported finding a belt of dead fish which stretched for 112 kilometres (70 miles). Incidents like this began to worry many people, and eventually several European countries signed an agreement not to dump dangerous wastes in the North Sea.

However, far more deadly things were being dumped in the large oceans. Radio-active waste from atomic power stations was regularly being dumped in the Atlantic. Small amounts of radio-activity may not kill fish but they do affect fish eggs and plankton. If all the plankton were to die it would mean the deaths of all other sea creatures (see pages 8 and 9). Phytoplankton produce 70% of the oxygen which we breathe – and if they die we may find ourselves running out of oxygen!

Already, radio-activity can be detected in any sample of seawater from anywhere in the world – and many types of plankton have been getting fewer in number for the past twenty years.

OIL SPILLS – THE MODERN MENACE

The oil tanker *Torrey Canyon* was one of the largest ships afloat. She was as big as three football pitches placed end to end, and she carried 119,328 tonnes of oil for the BP refinery at Milford Haven.

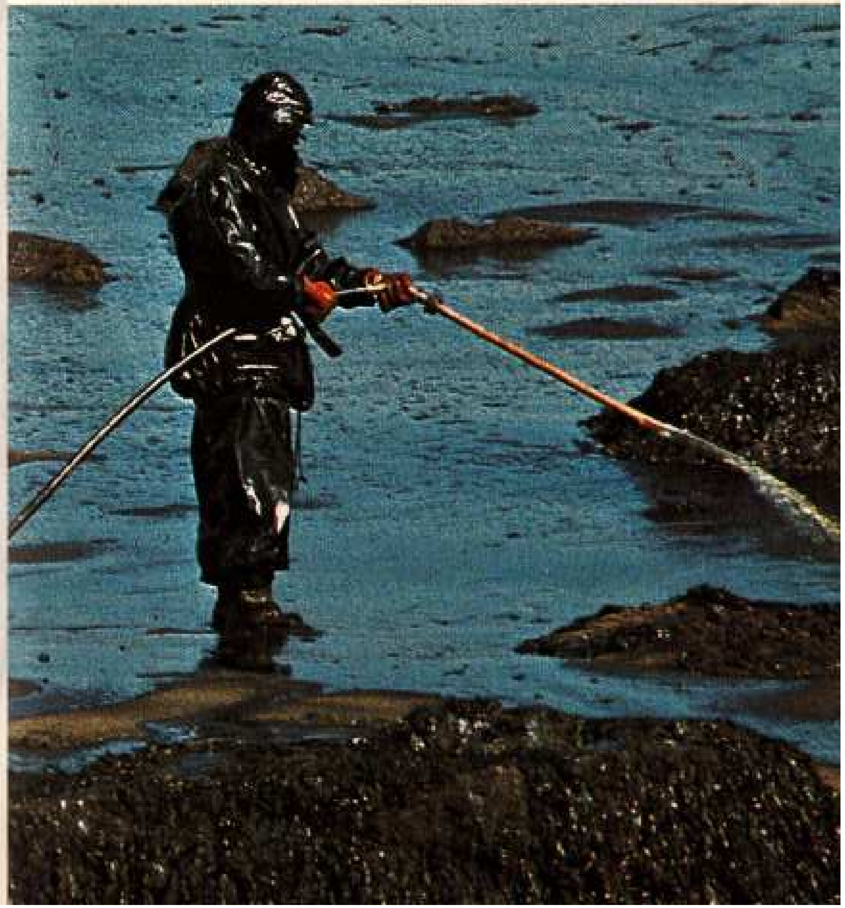
On Saturday, 18th March 1967, she was steaming northwards between Land's End and the Scilly Isles when she ran aground on the Seven Stones rocks. Immediately the oil began to flow out from her holed tanks, and by nightfall more than 25,000 litres (5,000 gallons) had already been lost.

By Tuesday 21st March, there was an oil slick 56 kilometres (35 miles) long and 32 kilometres (20 miles) wide drifting towards Cornwall. It was decided to bomb the ship to set fire to the oil and from the 28th to 30th March the RAF and Fleet Air Arm dropped 161 large bombs and 55,000 litres (11,000 gallons) of aircraft fuel. The oil in the ship was burnt but the oil on the sea continued to spread. The Royal Navy sprayed it with detergents for nearly a fortnight but they could not prevent its reaching the coast. By the 28th March, 160 kilometres (100 miles) of the Cornish coastline was polluted by oil.

It is estimated that tens of thousands of seabirds must have been killed and uncountable numbers of other sea creatures wiped out. Nearly 6,000 birds were rescued and cleaned, but many of them died of diseases and shock.

More deadly than the oil were the detergents used to clear it from the beaches. In an experiment, it was found that even a small amount was enough to kill 98% of the creatures in a rock pool – and over 5 million litres (a million gallons) had been used on the beaches!

Even while the battle to clear the oil was going on, another tanker was seen to be dumping waste oil at sea. We have laws to prevent oil dumping near the coast, but there is nothing to prevent ships from dumping oil at sea.



FISH FARMS FOR THE FUTURE

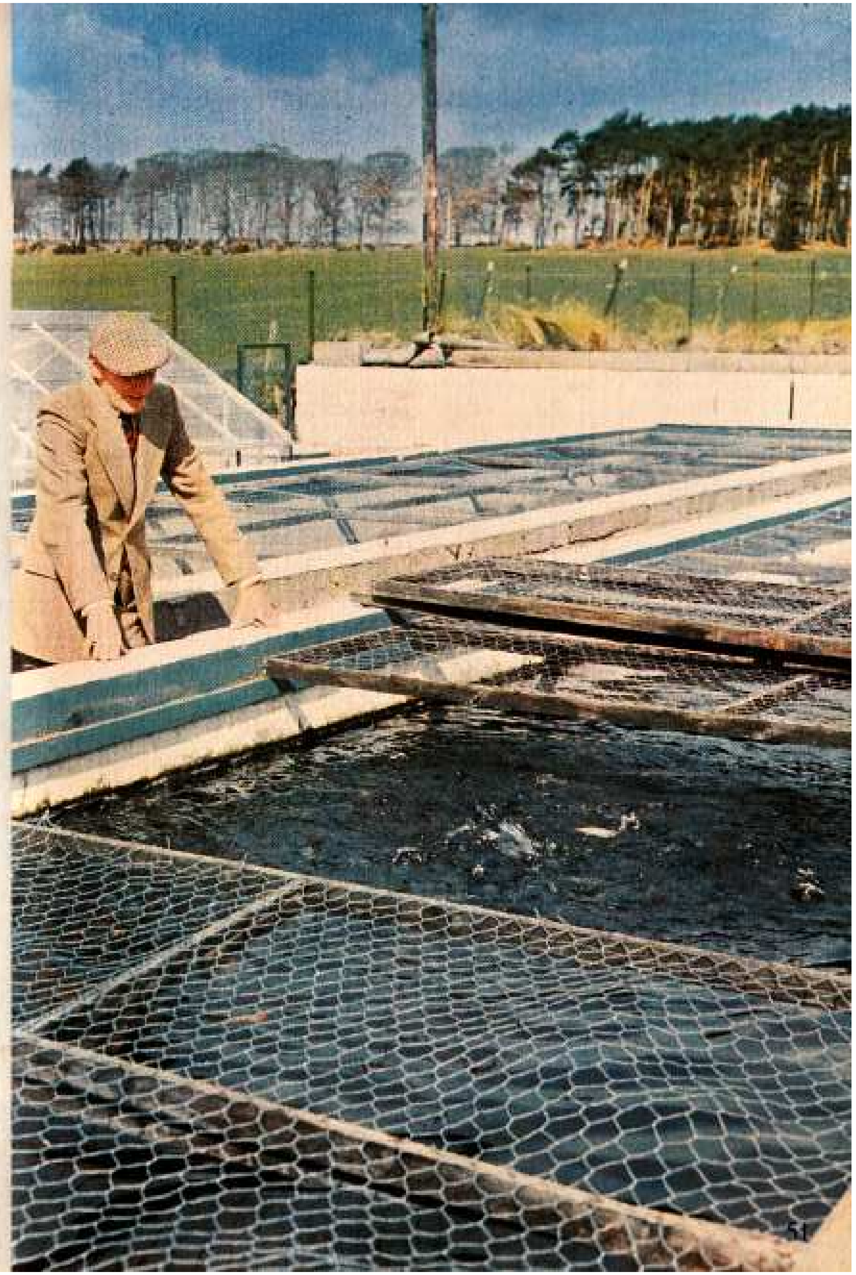
Although almost three-quarters of the Earth is covered by seas, we get less than one hundredth of our food from the sea. By the year 2000 there could be twice as many people in the world as there were in 1970. How will we feed 6,000 million mouths? We will have to get more food from the sea, but this cannot be done by more fishing. Already the best areas have been over-fished, and catches have been getting smaller for several years. The answer to the problem may be to farm sea creatures as we now farm land animals.

Sea fish are very difficult to rear in tanks. Dr James Shelbourne spent ten years (1951 to 61) working at the Marine Research Laboratories in Lowestoft before he succeeded in hatching and rearing worthwhile numbers of young plaice.

In 1962, work began on Britain's first seafish hatchery at Port Erin in the Isle of Man, and in 1964 they were able to rear 160,000 young plaice to postage-stamp size.

In 1965 200,000 plaice were released in an enclosed sea loch at Ardtoe in Scotland, but heavy rain made the seawater too fresh and most of the fish died. Others were placed in warm water tanks at Hunterston Nuclear Power Station. These grew to marketable size in under two years compared to four years in the sea.

There are now a number of fish farms in Britain. More are being considered, in view of the increasing cost and restrictions on commercial fishing.



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